AMATEUR WORK

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STUDIES IN ELECTRICITY.

DONALD M. BLISS.

V. ELECTRO-MAGNETISM AND INDUCTION.

If the electro-magnet used in the last experiment be removed, and one of the battery wires held an inch or so above a compass needle, or the floating magnetized needle referred to in the last chapter, the wire is in such a position that it is parallel to or runs north and south with the needle, as shown in Fig. 15; as soon as the circuit is closed and a current flows through the wire, the needle will be instantly deflected to the east or west, according to the direction of current in the wire. This simple experiment, first tried in 1820 by Oestred, forms the starting-point of the electro-magnet. Farraday found that this experiment

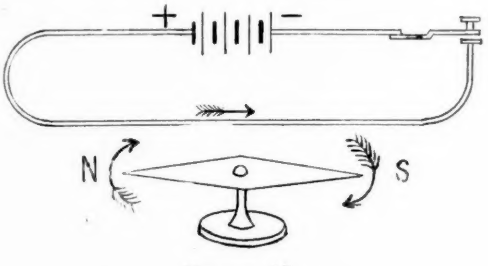


FIGURE 15.

was reversible; i.e., if the needle be kept from moving and a closed loop or circuit of wire moved across or towards the magnet, a current would be generated in the wire by this movement, and would last so long as the motion continued. These two great discoveries, electro-magnetism and the induced current, have done more to benefit and advance the human race than any other investigations in natural science. Without the electro-magnet and the discovery of induction, neither the telephone, telegraph, electric light or power systems, and a thousand and one practical applications of electrical science, would be known at the present time.

The student should by all means repeat this classical experiment in various ways until he has a clear understanding of the principles involved, and as the little apparatus required may easily be constructed by the amateur worker, there should be no excuse for neglecting this important branch of electrical study.

The most important piece of apparatus required is a simple galvanometer or current detector. This is shown in Fig. 16, and consists practically of a spool of insulated wire in a certain relation with the compass. The spool consists of a block of wood in the shape of a flattened spool with the dimensions as shown. The space between the heads is wound with about three ounces No. 28 cotton-covered magnet wire, the ends of the winding being connected to binding screws on each end of the spool, as shown. A cheap pocket compass is mounted on one side of the spool just over the coil. This may be held in position by screws or pins, which should be of brass, which is non-magnetic, and should be adjusted so that the compass may be turned at any angle desired. When in use, the block should be placed so that the wire or coil is in the same direction or parallel with the needle when at rest, i.e., north and south.

In selecting a compass, see that the needle moves freely in every direction. If the compass is held level and slowly rotated, the needle should show no tendency to follow the movement, but remain pointing north and south. In addition to

the galvanometer a small quantity of small iron filings and some pieces of cardboard and stiff paper should be provided; also a small horseshoe and a straight permanent magnet, made as described in previous articles.

Referring to the experiment shown in Fig. 15, it is evident that as the magnetic needle can only be deflected by the presence near it of a magnetic

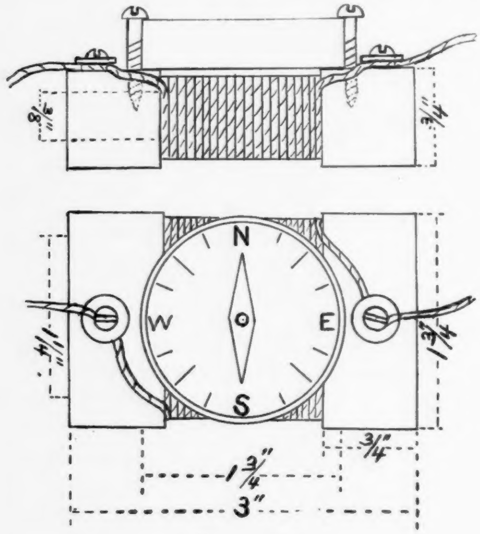


FIGURE 16.

field or influence, and as there is no iron or other magnetic substance near the needle to cause such a movement, the presence of an electric current in the wire must create a magnetic field outside the wire in such a manner as to tend to force the needle at right angles to the flow of the current. Hence the important rule that a current of electricity, whatever its source, always produces a magnetic field at right angles to its flow.

This fact may always be shown very nicely by sending a current through a wire which has been passed through a piece of cardboard, as shown in Fig. 17, and sprinkling some fine iron filings around the wire. As soon as the circuit is closed and the card tapped gently, the filings will arrange themselves in circles around the wire, and of course at right angles to the current. The magnetic field produced by the current may therefore be conceived as forming spirals or whorls of magnetism, which are generated at the surface of the wire and extend outward in every direction,— something after the idea shown in Fig. 18, but to a much greater distance.

As the magnetized compass needle (Fig. 15) is continually under the influence of the earth's field or polarity, it will not place itself exactly at right angles to the current flowing from it, but will take up a position depending on the relative strength of the two forces, the earth's magnetism and the current; the former tending to keep it

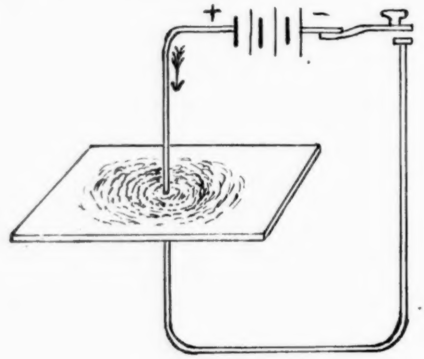


FIGURE 17.

north and south, and the other at right angles to the current, or parallel to the magnetic lines of force around the wire.

If, instead of surrounding the wire with iron filings as shown in Fig. 17, we reverse the experiment and surround a short rod of iron with insulating wire by winding it as shown in Fig. 19, we have an elementary form of the electro-magnet. And here a convenient way of determining the polarity of a magnet in any given case may be noted. If the wire is wound on in a right-handed spiral, and the positive ends of the battery are connected as shown, or so as to flow in a right-handed direction, the end of the magnet you are looking at will be a south pole. Briefly, as S follows R in the alphabet, so polarity follows right-hand rotation of current.

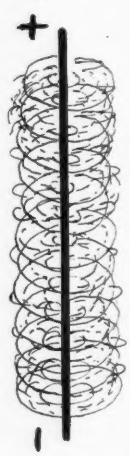


FIGURE 18.

A practical electro-magnet, of course, has many turns of wire upon it, but so long as the direction

of winding is not reversed, it makes but little difference whether the wire be wound uniformly from end to end of the iron core, or whether it is tapered towards the ends, or *vice versa*, the result and strength of the magnet is practically the same.

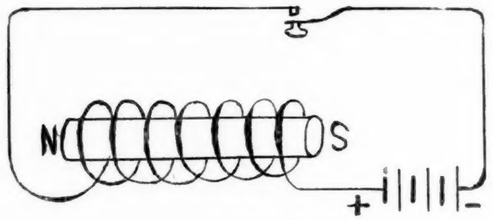


FIGURE 19.

We can now proceed with some interesting and easily performed experiments illustrating the production of induced currents.

Experiment 1. Take a wooden spool having a $\frac{1}{4}''$ or $\frac{3}{8}''$ hole through it (a thread spool will do) and wind it full with No. 28 or No. 30 single cotton-covered magnet wire, leaving the ends of the wire a foot or so long. Connect these ends to the terminals of the compass galvanometer. Then close the circuit through your large electro-magnet and battery described in the January number of AMATEUR WORK. Now move the spool to and from one of the poles of the electro-magnet, or pass it across the ends of it, and you will note that whenever the coil moves towards the magnet the compass needle will swing in one direction, and when the coil is pulled away the needle will swing in the opposite direction; and so long as the coil is kept in motion near the poles of the electro-magnet, a current will be generated in the little coil and affect the needle, though the coil itself has no visible connection with the battery. This experiment may also be repeated with the permanent magnet, and the same results will be noted, though in a less degree, owing to the comparatively weak magnetic field of the permanent magnet.

These effects show that magnetism, however produced, has the property of generating a current under certain conditions, as well as attracting iron or other magnetic metals. These conditions are present whenever a metal or other conductor of electricity is kept in motion within the influence of a magnetic field, and the more nearly the motion of the conduction is at right angles to this field, or lines of force, as they are now called, the greater the induced current, other conditions being equal.

If, instead of moving the coil across the poles of the magnet, it is held near one of them and the battery current through the magnet be made and broken, it will be seen that when the circuit is closed the needle will be violently deflected one way and then come to rest, and when the battery current is broken it will swing even more strongly in the opposite direction. In this case we have simply reversed the conditions by keeping the coil still and quickly sending the lines of force through the coil on closing the circuit, and as quickly withdrawing them by breaking the current producing the magnetic field.

The current generated in the little coil is called the induced or secondary current, and this is the source of power developed by the dynamo in electric light and power service. These machines are so designed that the coils of wire on the revolving part, called the armature, are rotated within a powerful magnetic field, and the currents so generated led therefrom to the lamps, motors or other devices.

The induction coil and transformer operate under the same conditions as the stationary coil and interrupted current. Here no mechanical movement of the coil takes place, but the magnetic field produced by one winding, called the primary coil, is rapidly interrupted or reversed, and a secondary or induced current is generated in the other coil, or secondary winding, with each change in the magnetic field.

THE officials of the Canadian Pacific Railway have at present under consideration an immense scheme for the irrigation of the northwest of Canada, by which it is proposed to make good farming and grazing country out of the millions of acres which are dry and arid between Calgary and Medicine Hat, on the North Railway line. James Anderson, one of the leading irrigation engineers of the world, has recently traversed this area, and reports that there is nothing to prevent this work being successfully carried out. His report is being considered by the Canadian Pacific authorities, and it is understood that, as an experiment, 300,000 of the 3,000,000 barren acres will be put under irrigation.

A SMALL ELECTRIC MOTOR.

Donald M. Bliss.

The small electric motor illustrated herewith is well adapted for operating model electric cars and light machinery. It will not develop more than $\frac{1}{20}$ horse-power. It can be driven to the best advantage by five or six cells of bichromate battery or ten to twelve cells of gravity battery. It will also operate satisfactorily for short intervals on eight

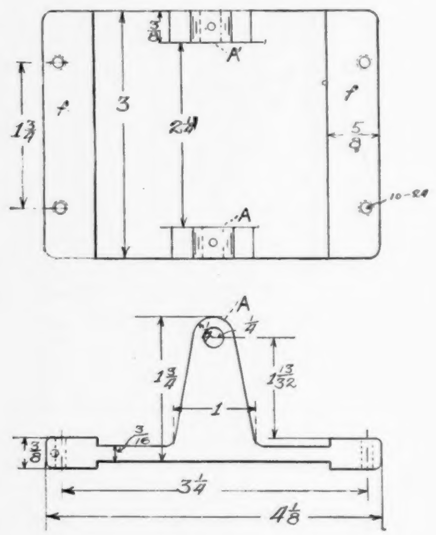


Figure 1.

and ten cells of the Leclanche or a similar type of battery. Of course in the latter case it must be remembered that such a battery is only suitable for intermittent work, and cannot be relied upon to run the motor for more than a few moments at a time. It is exceedingly simple in construction and consists practically of only three parts: the base, magnet frame and armature. The base and magnet frame (see Fig. 1) should be made of soft cast iron. The frame should be secured to the base by four screws, as shown. The holes for these screws in the frame should be about $\frac{1}{16}$'' larger than the screws, to allow for a slight adjustment in any direction. The corresponding holes in the base should be drilled and tapped for a 10-24 round-head machine screw.

The surfaces of the base and corresponding part of the frame may be ground, filed or planed so that when the parts are assembled the holes in the bearing standard A,A' should be exactly in the center line of the field bore B. If clean, sharp castings can be secured, it will not be necessary to bore out the field frame B. If it is impossible to secure good castings, this base should be bored out, as shown, to the diameter of $1\frac{13}{16}$''. The armature shaft D is simply a straight piece of quarter-inch soft steel rod, which should be filed and polished until it fits easily and freely the bearings A,A'. These bearings should be drilled, using care to see that they are lined squarely across the base. An oil hole in each standard should be drilled at the same time.

The armature E should also be a soft iron casting, and is provided with three poles and coils, as shown. The head of the armature is extended sufficiently on one end to carry a three-part commutator, F, while the other end is prolonged so as to form a bearing shoulder when the armature is placed on its shaft. It may be found necessary to turn the armature, if the casing is not true, to a diameter of $1\frac{3}{4}$''. After the hole in

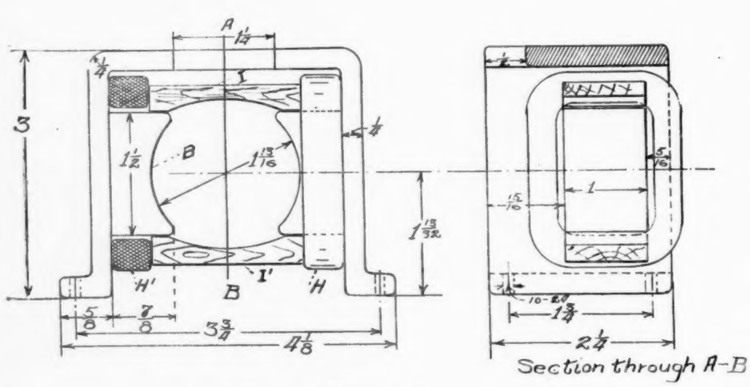


Figure 2.

the center of the armature for receiving the shaft has been drilled, it should be mounted on an arbor and accurately turned in a lathe to the required

size. When this is done, go over the castings carefully, file away all sharp points and corners, so that when the wire is wound on there will be no danger of injuring the insulation.

Then cover the three arms of the armature carefully with two layers of thin cotton cloth. This can be held in place by winding a few turns of thread around the various parts and painting them well with shellac varnish. When thoroughly dried, each limb of the armature should be wound with from forty to fifty turns of No. 20 single cotton-covered magnet wire, leaving several inches of wire at each end for connections. The inside ends of the coils thus formed should be twisted together and soldered, while each of the outside ends should be connected to one of the three segments on the commutator. These connecting ends should not run down straight to the commutator, but should be left long enough so as to admit of turning the commutator on its bearing in either direction, to allow for correct adjustment. The commutator itself may be made of a short piece of $\frac{3}{4}''$ brass or copper tubing, sawed apart so as to form the three segments as shown. These segments are mounted on the hard rubber or fiber sleeve, G. In this sleeve is bored a $\frac{3}{8}''$ hole, so that it may be mounted on the extended hub of the armature, as shown. If fitted tightly on the shaft, it will not be necessary to use set screws to hold the sleeve in place. If necessary to use a set screw, it should be drilled and tapped into the fiber, and not touch one of the segments of the commutator, as this would injure the winding of the armature, and possibly lead to a short circuit or ground.

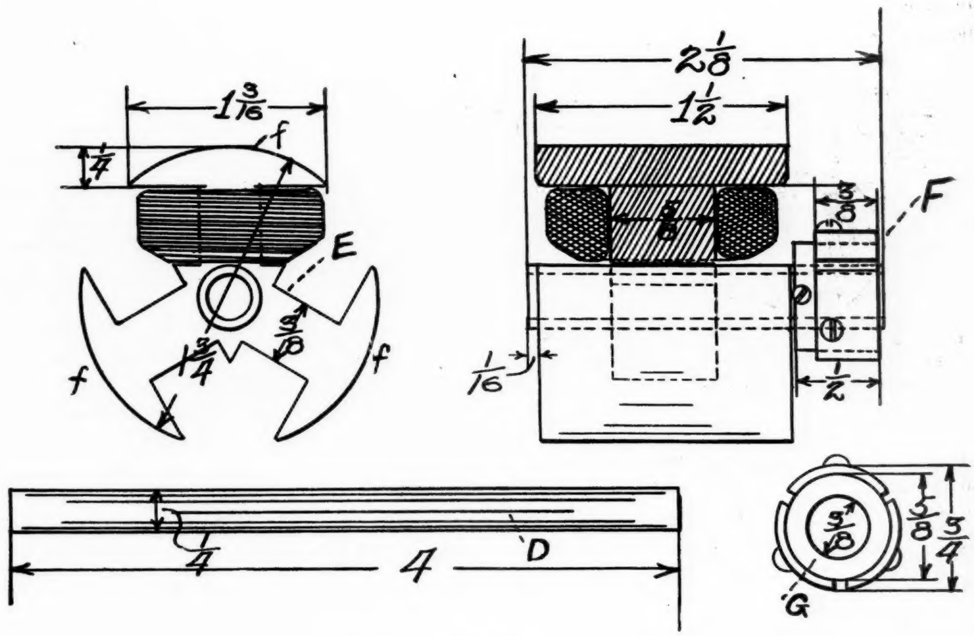


FIGURE 3.

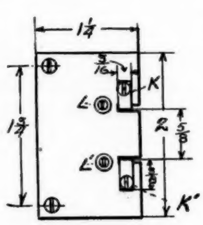


FIGURE 4.

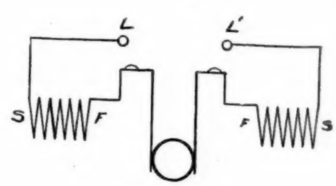


FIGURE 5.

Referring again to the field frame (Fig. 2), the two field coils, H and H′, may be made. Each

coil consists of about four ounces of No. 18 single cotton-covered magnet wire. This may be wound upon a wooden arbor about $\frac{1}{8}''$ longer and wider than the field coils, which, it will be noted, are $1\frac{1}{2}'' \times 1''$ in section. This winding arbor should have two heads turned and screwed thereon, so as to leave a winding space of the same size and section as the coil. A space $\frac{1}{2}''$ wide x $\frac{1}{2}''$ deep will be found sufficient for this. Before starting the winding of these coils, lay three or four strips of thin tape 6″ long across the winding space on the arbor, and wind the wire carefully in even layers

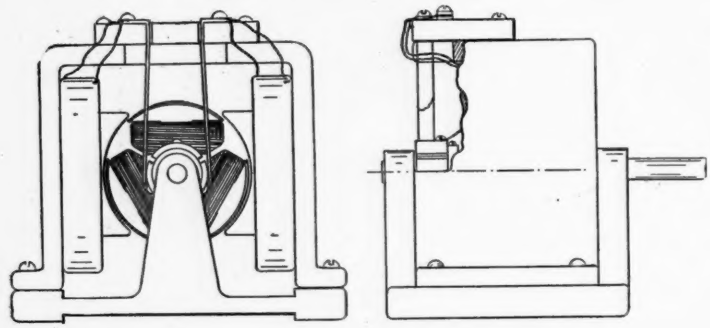


FIGURE 6.

in this space. After the required amount has been wound on, the tape may be tied together tightly, one of the heads taken off, and the coil removed from the arbor. Before fitting the coil on the pole-piece, it should be wrapped all over with two layers of thin cotton tape, so that the wire will not be exposed at any point. The coils should then be well painted with shellac varnish, and allowed to dry before being placed on the frame. The two coils are held in place, when mounted on the pole-pieces, by wooden cleats forced in between them, as shown at I′.

The terminal board and brush-holding device is shown by Fig. 4, and is made of a block of fiber or hard wood, of the dimensions shown. The brushes K,K′ are simply two strips of hard-rolled copper about $\frac{1}{4}''$ wide and $\frac{1}{32}''$ thick, bent at right angles, and mounted in such a position that when the terminal block is fastened to the top of the frame, as shown in Fig. 6, they will touch on the opposite sides of the commutator in a vertical position. The connecting terminals of the motor L-L′ are simply two short machine screws provided with copper washers. These screws are drilled and tapped into the fiber head, but should be placed so as not to bear on the iron frame, otherwise a short circuit will result.

See that the armature is centered in the frame, so that it will revolve freely with an equal clearance from the pole-pieces at all parts of its diameter. This clearance will not be less than $\frac{1}{32}''$. Adjust the armature on the shaft so that it turns freely and is central with the poles. The armature may be held in position on the shaft by a set screw or by making a snug driving fit.

If the foregoing directions have been properly followed, the motor may be now connected up, as shown in Fig. 5.

The wire is run from the binding-post L, and connected to the inside end of one of the field coils. The outside end of the same coil is carried up and connected to one of the brush-holding screws. Another wire is run from the remaining binding-post to the inside end of the other field coil, and the outside end of the same coil is connected to the remaining brush-holding screw. This connection is clearly shown in Fig. 5, and when so arranged is termed "series" winding. This is the most suitable connection for a motor of this type and size. Any desired form of pulley, or a small gear, may be fitted to the outside end of the armature shaft, and the motor is ready to run.

If it does not start promptly at first, the commutator may be turned slightly on the shaft in one direction or the other until the best position is found which will give the greatest turning power with the least amount of sparking. Being a series-wound machine, the speed will be constant only under a steady load. Great care should be taken to see that all the windings are thoroughly insulated from the frame or other metal parts, and when the machine is completed it should be given a coat of light enamel paint, which will improve its appearance and prevent rust. The commutator and brushes should be kept clean and free from oil.

Do not attempt to run this motor directly from an electric-light circuit. If it is desired to pro-

duce such a current, it should be as connected in the series, with a sufficient amount of resistance to cut the current down to an amount equal to that derived from the battery. It is necessary, both for ease of construction and to secure efficiency, that the castings composing the frame and base be of soft iron. If this point is not attended to, you will probably get iron castings so hard that it will be almost impossible to work them, while the operation of the motor will be unsatisfactory. Unless you are familiar with metal working in the lathe, it will be advisable to have the fitting and centering of the parts done by a machinist. The expense for this will not be large and should not deter one from building the motor. If you are the fortunate possessor of a small engine lathe, you can easily do all the work yourself.

The construction and operation of this little motor will give you a good insight into the operation and principles involved in motor construction, and it will be found very convenient in driving model machinery. The battery described in the December number of AMATEUR WORK, with the cells in series grouping, is well adapted for operating this motor at its full output. If gravity battery only is available, it is advisable to wind the armature and field coils with fine wire, No. 24 B & S gauge for the armature and No. 20 for the fields. As the greatest output to be expected from twelve cells of gravity battery would be twelve volts, at less than one-half an ampere or something under six watts, it is evident that only a small amount of power can be derived from a battery of the gravity type. The ordinary open circuit or Leclanche battery with large zincs will deliver fully twice as much current, but, as stated above, only for momentary work, owing to the rapid polarization of this type of battery. The most satisfactory results can be obtained from the bichromate battery, which you can easily make yourself.

AN ELECTRIC QUESTIONER.

WILLIAM SLYKE.

I HAVE here attempted to describe an instrument or rather a scientific novelty, with which I believe many an evening can be passed pleasantly by the readers of AMATEUR WORK. It is certainly a simple instrument and costs less than a dollar to make. It is what might be called "An Electric Questioner." The first thing needed for such an instrument is a box about 15″ long, 6½″ wide and 3″ deep, the wood of which should not be more than ½″ thick. Draw a straight line across the

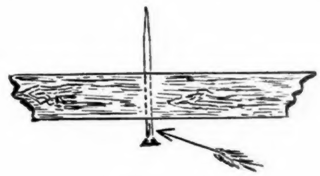


FIGURE 1.

center of the box. On one side of the line will be the questions, on the other the answers. Procure 36 ordinary wire shingle nails. Nail 18 of the nails on one side of the line and 18 on the other side, having the heads of the nails on the inside of the box, and the points sticking through the top of the box. Do not drive the heads of the nails tight against the top, but leave a small space

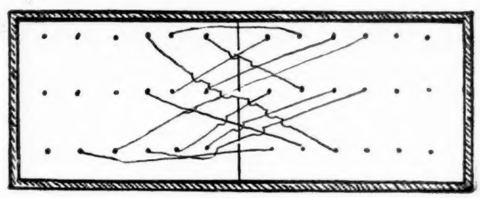


FIGURE 2.

between the top of the box and the head of the nail, as in Fig. 1. When all the nails have been put in, get about 20 feet of cotton-covered magnet wire about No. 20 gauge and cut it into lengths of about 14″. Remove the insulation for about

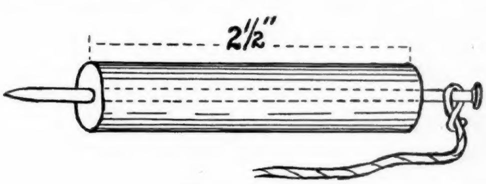


FIGURE 3.

1″ from each end. From the heads of each of the 18 nails on the question side wind the end of one of the lengths of wire and bring it to any one of the heads of the nails on the answer side of the box. Do the same with each nail, as shown in

Fig. 2. Only a few are shown in the illustration, to avoid confusion.

When all the wires are attached, the nails can be hammered all the way in. When completed, the inside of the box will be a network of wires. Now get an electric bell, or, better still, a buzzer, as a bell makes too much noise. Screw the buzzer to the edge of the box in the center, as shown at A, Fig. 4.

Two handles or electrotudes should then be made. These can be made by cutting a piece of wood round about $2\frac{1}{2}''$ long and $\frac{1}{2}''$ thick. Drive a long wire nail through the wood so as to protrude through the other end an inch, as shown in Fig. 3. The wooden handles used by provision dealers for bundles will serve nicely. Solder a piece of flexible insulated copper wire about 1′ long to the head of the nail A, Fig. 3. Do the same with the other handle, and connect the other ends of the wires as follows: Screw the end of the wire attached to one of the handles to the binding-post on the buzzer, screwing it on very tight. The other handle should be screwed to the binding-post of a "dry battery." From the other binding-post of the battery attach a piece of wire, and bring it to the remaining binding-post on the buzzer. (See Fig. 4.)

Now test the working of the instruments. Take one of the handles and hold the metal tip to any of the nails of the 18 on the question side. Take the other handle and tap each of the 18 on the answer side until the buzzer sounds. Do the same way with each of the nails. If your instruments work thus far, you are sure of success.

The next and last thing is to make the cards on which are the questions and answers. Get a sheet of white cardboard that is not too stiff, and cut it the size of the top of the box. The width is taken from the end of the box up to the buzzer, but not covering it. Put dots on the cardboard where each nail strikes, and punch holes where each dot is. Now push it over the nails until it reaches the top of the box. Print or write below one of the "question nails" a question, riddle or conundrum. Hold one of the handles to the nail which has the question; take the other handle and tap the answering nails until the buzzer sounds, then write the answer below that nail. Do the same with all the nails, until one side of the card is filled with questions and the other side with the answers. To work this instrument, you put a card over the nails, take a handle and hold it on the nail which has the question you want answered. Take the other handle and tap the answering nails until the buzzer sounds. You then read the answer to the question. If the instrument is made right, and the insulation of the wires in the box unbroken, you will always get the correct answer. Of course the instrument can be made larger or smaller to suit the taste of the maker. The battery may be put inside the box and a bottom nailed on to prevent it from falling out. This instrument will be found both practical and entertaining. Additional cards can be made with many instructive questions in United States history, geography, or with conundrums, etc. If the nails are all driven in straight, the cards can be put on or removed without difficulty.

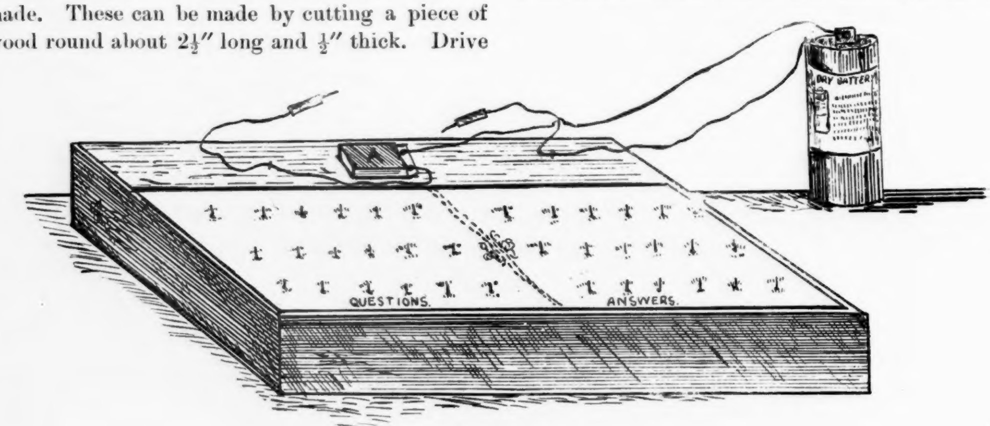


FIGURE 4.

OLD DUTCH FURNITURE.

JOHN F. ADAMS.

V. HALL SETTLE.

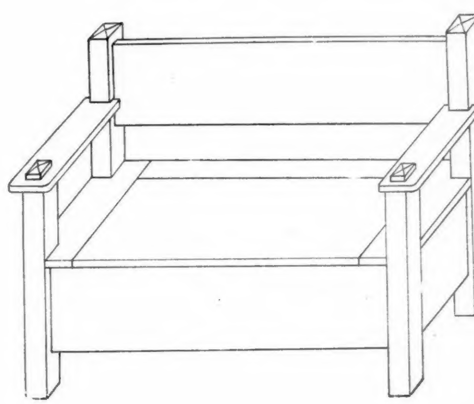
THE hall settle here described is a very convenient piece of furniture. The box-seat forms a very handy receptable for rubbers, etc. Like the furniture previously presented, it should be made of oak. The corner posts are 2½″ square, the front ones being 27″ long and the back ones 33½″ long. The boards forming the sides of the seat are ¾″ thick and 9″ wide, planed on both sides. The pieces for the front and back are 44″ long and for the sides 12″ long. The lower edges of these pieces are 6″ from the floor.

Mortises ½″ deep are made in the posts to receive these pieces. They should be the full size of the board, and centered in the posts, the lower ends of mortises being 6″ from the bottom ends of the posts. Mortises are also cut ½″ deep for the board forming the back. This board is 44″ long, 10″ wide and ¾″ thick. The upper edge should be 1½″ from the top of the posts, which are beveled to a point, as shown in the illustration. The bevels take ½″ of the tops of all the posts. The tops of front posts after beveling are cut down ¼″ on each side for 1½″, forming a shoulder, on which rests the front ends of the arms. This may be easily done with a backsaw, and then smoothed with sandpaper. This leaves the tops of these posts 2″ square.

When the work so far described is completed, the frame should be set up, the pieces being glued into the mortises and also fastened on the inside of the seat-box by screws, which run into the posts. The board for the back should be put in at this time. The end pieces for the seat are then fitted. They are 16″ long, 6″ wide and ¾″ thick. Pieces are cut out of the outside corners to allow room for the posts, the outside edges and ends being flush with the sides of the posts at front, sides and back. Care should be used in fitting these pieces to get good square fits. The rear inside ends should be halved on the underside, to receive the ends of the rear piece that runs lengthwise of the seat. If a piece 4″ long, 1″ wide and ⅜″ thick is taken off, the joint will be strong enough.

The rear piece for the seat is 38″ long, 4″ wide and ¾″ thick, allowing 1″ on each end for halving to fit the end pieces. See that the inside edge is straight, as should also be the inside edge of the board forming the seat. The seat is 36″ long, 12″ wide and ¾″ thick, and should be a snug fit to the seat pieces, already described. If a good board of this width cannot be obtained, the rear piece may be made 6″ wide and the seat 10″ wide, but the dimensions previously given are the best.

The side and back pieces of the seat are attached to the frame by screws, countersunk and covered with putty. The putty should be colored with stain, so that, should it crack or become dented, it will not be conspicuous. The seat is attached to the rear piece by three brass hinges, which should show as little as possible. The arms are 16″ long, 5″ wide and ¾″ thick. The front



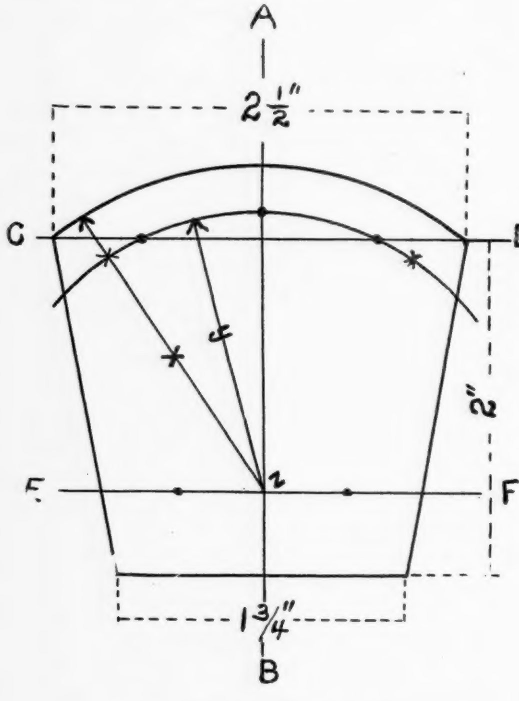
corners are slightly rounded. Holes are cut in the front ends to receive the tops of the front posts. These holes should be 2″ from the front end and 2″ square. The back ends are cut down 1″ to fit around the back posts, as shown in the illustration. The arms should be strongly attached to the posts with glue and screws, the heads being countersunk and covered with the stained putty.

The bottom of the seat-box is made of whitewood ⅞″ thick. This will require a board 44⅝″ long and 12⅝″ wide. The corners will have to be cut out to fit around the posts. It should then be well nailed with wire nails, first drilling holes through the oak side pieces for the nails, to prevent splitting, and covering the holes with putty.

To prevent the seat from splitting, three strips 10″ long, 1½″ wide and ½″ thick may be secured on the underside, with four screws to each strip.

They should be zigzagged, with the heads countersunk.

When completed, go over the whole surface with fine sandpaper, then stain with a very dark stain. When the stain is dry, put on a coat of very thin shellac, and rub over with a coat of polish, applied with a soft cloth. A hair-stuffed velvet cushion of the same shade as the stain adds much to the appearance of the settle. A mirror with clothes-hooks, to hang over the settle, will be described in another article.

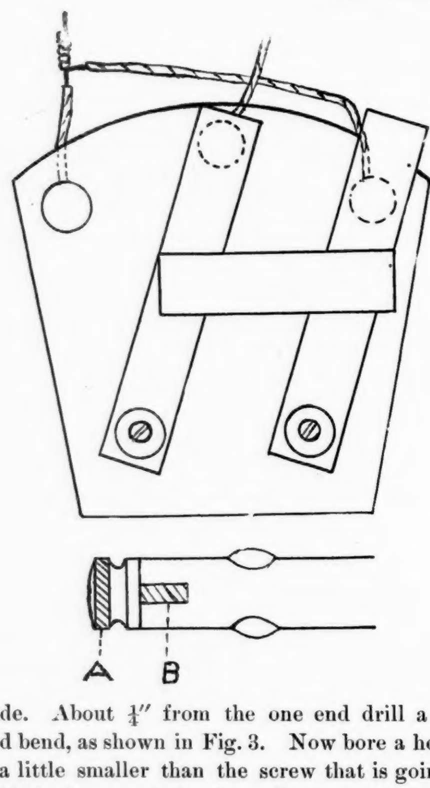


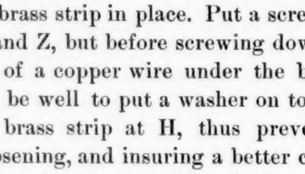
CURRENT SWITCHES.

E. F. BECK.

IN experimenting with electricity, one often needs a switch connected in the circuit. It may be a one-point, two-point or a pole-changing switch that is desired. These may be made as follows:

First, get some tops of old battery zincs, A (Fig. 1), which may usually be had for the asking at any telephone central station. Second, a piece of pine wood about 3" square and $\frac{1}{2}''$ thick. Draw a keystone on it, using the dimensions given in Fig. 2. Place a dot $\frac{1}{2}''$ up on the line AB at Z, and with that as a center, describe the two arcs with x and y as a radius, y being $1\frac{3}{4}''$. At the points where the arc, made by the radius y, intersects lines AB and CD, place a dot. The base can now be cut out with a jack-knife. At the three dots, drill holes a little smaller than the screw B (Fig. 1) so that they can be made firm. Take three of the zinc tops and screw them in securely. At the side of each, drill a hole large enough to admit a 16 or 18 gauge wire. Next obtain a piece of brass or other conductive substance about $2\frac{3}{4}''$ long and $\frac{1}{2}''$





wide. About $\frac{1}{4}''$ from the one end drill a hole and bend, as shown in Fig. 3. Now bore a hole at Z a little smaller than the screw that is going to hold the brass strip in place. Put a screw through holes H and Z, but before screwing down, put the bare end of a copper wire under the brass strip. It might be well to put a washer on top and below the brass strip at H, thus preventing the screw loosening, and insuring a better connection. Then bring the wires up through the three holes

and fasten around the grooves in the points. If desired, a hole can be drilled through the other end of the brass strip and a nob attached. Screw holes should be made in the base for the screws that hold it down.

A pole-changing switch will need two strips of brass, three points and a similar base, with few exceptions. The holes drilled on the line CD will be placed further back on the arc (Fig. 2), at the places marked with a cross. Draw a line EF through Z parallel with the back of the switch, and at a point ½″ each side of Z place a dot. Take the two strips of brass, drill a hole in each a short distance from the end, and bend as Fig. 3, and 1″ from the other end drill a small hole in each of the strips. A piece of wood 1½″ long and ¼″ square will serve as a handle. Find the center and bore two small holes 1″ apart, and put two round-head brass screws up through the strips into the handle. Now drill two holes on the line Z, at points already marked, and insert screws, as before, through the brass strips into the base, using washers if possible, and putting a wire under each strip. The two outside points must be joined together, forming one line, and the other one will be the wire from the central point. They should be fastened, as before, by twisting around the grooves, and soldered if possible.

WEATHER STUDY.

The ancients personified their winds, the name Boreas, the god of the north wind, being in use to this day, while parts of the Old Testament are full of weather lore. This but shows that from the earliest times man has taken note of the varying conditions of the weather. At the present time this is especially true, and it is an axiom that all are interested in it, from the man who manages large commercial or manufacturing interests, to the washerwoman who is anxious as to whether to-morrow will be a good "drying" day or not. In view of this it is very desirable that all should have a clear understanding of storms, their probable movements from day to day, and their results so far as temperature, precipitation and high winds are concerned. It should be possible for everyone to be able to forecast the weather for himself with the aid of the daily weather map issued by the United States Weather Bureau.

To the writer there appears to be but one feasible way in which to bring about this much desired result, and that is through the medium of the public schools.

Probably one-half of the population of the United States do not attend school beyond the grammar grade; it is therefore necessary, in order to be of benefit, that their instruction begin in the primary grades and be continued through the grammar. As to the method to be pursued, I think, in such a course, the instruction should be centered around the daily weather map. After the pupils have been taught what a storm area is, the course of each, as shown in these maps, should be carefully followed across the country. After its passage, all the maps upon which it appears should be assembled and a careful study made of all the phenomena connected with it. Comparisons should also be drawn between it and other storms. If there are points of similarity, they should be plainly brought out.

This method should be carried on through the whole school course, and in connection with it some knowledge may be gained of what are known as the meteorological elements: the pressure, temperature and humidity of the air; precipitation of its moisture, evaporation, the winds, the clouds, and the electrical and optical conditions of the atmosphere. Unless one wishes to follow the study of the weather as a vocation, it is not necessary to go too deeply into the scientific side of it, as without so doing one can by practice learn to make an approximately correct forecast for the following one or two days. All know how uncomfortable is a warm, "sticky," summer's day, even if the temperature does not reach a high mark, but few know why it is so or can give a lucid explanation of it. Some few facts like these should be understood by everyone. The ignorance on this subject displayed by people, otherwise intelligent and well educated, is truly lamentable, in view of the fact that so much in the way of personal comfort and public and private gain and safety depends upon the weather. There is no doubt but what many of you think that a storm that brings to Boston driving rain and high winds from the northeast really comes from a northeasterly direction, whereas the contrary is usually true, except in the rare instances when a storm moves up the Atlantic coast from the West Indies. METEOROLOGIST.

AMATEUR WORK

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MARCH, 1902

Contents

	PAGE
STUDIES IN ELECTRICITY, V., *Donald M. Bliss*	99
A SMALL ELECTRIC MOTOR, *Donald M. Bliss*	102
AN ELECTRIC QUESTIONER, *William Slyke*	105
OLD DUTCH FURNITURE (Hall Settle) . .	106
CURRENT SWITCHES . . . . *E. F. Beck*	108
WEATHER STUDY . . . . *Meteorologist*	109
MECHANICAL DRAWING, V., *Earnest T. Child*	111
A CAMERA OBSCURA	116
ASTRONOMY FOR MARCH . . . . *Vega*	117
DEVELOPING PLATES	118
HOW TO BUILD A HOUSEBOAT, *C. H. Clark*	119
CORRESPONDENCE	122
LEECHMAN'S LECTURE . (Motor Bicycles)	124

THE recent extensive development of manual training schools, with wood and metal working equipment, is a long-delayed but very welcome addition to school work. Aside from the educational benefit, the training received in the use of tools will be valuable in after lifetime, if to no other purpose than the ability to do constructive and repair work in the home. Such training is not restricted to these narrow limits, however, but embraces the mercantile and manufacturing field as well. The knowledge acquired in such a school broadens and develops the perspective, and fits the graduate for many kinds of business life as does no other form of school work. This is now becoming so well recognized by those interested in educational work, that manual training courses will soon form a part of the curriculum of every school.

TO THOSE who are without a complete outfit of tools the plan adopted by several young men in one of the cities adjoining Boston may be of interest. They united to form a work-club or guild. One had a barn which was not in use and which was fitted up with workbench, tool-chests, etc., as a workshop. Each one purchased a part of the outfit of tools, which he owned, but which all used in common. Any one breaking a tool replaced it with a new one, retaining the broken one. A small contribution from each paid for the light and heat. Many of the tools were obtained as premiums for new subscribers for AMATEUR WORK. This plan could undoubtedly be used to good advantage by many of our readers.

THE increasing interest in AMATEUR WORK shown by our readers is greatly appreciated by the publishers. Our thanks are extended for the many helpful suggestions received. It is by such means that the usefulness of this magazine can be enlarged and its facilities extended for providing interesting topics. If any reader has constructed any device which would be of general interest to our readers, a description of it would be welcome and the same published as soon as space permitted. Several articles contributed by readers appear in this and the next number.

A LIMITED number of back numbers of AMATEUR WORK may be obtained by ordering from newsdealers or sending direct to this office, enclosing ten cents for each copy desired.

MECHANICAL DRAWING.

Earnest T. Child.

V. Cross-hatching and Sections.

In our last talk the subject of sections was taken up, and a few of the conventional lines used in showing sections of various materials were given. The proper use of sections is of such great importance that further consideration is necessary, and the student will do well to study the matter of sectional representation very carefully. This is necessary in order that a clear understanding of the subject may be acquired. The best method for attaining proficiency is by constant practice, and this point should be borne in mind by the student who hopes to become a professional draughtsman. One may look at drawings and read books on the subject, but not until he actually learns to use draughting instruments properly, by careful and continuous practice, will he begin to advance towards the desired end.

It is not meant by this that every spare moment should be devoted to practice; but a certain time, say two or three evenings a week, should be set aside by the student and devoted to it. The writer, although a professional draughtsman, devoted two evenings a week for seven consecutive winters to various classes of drawing which were not included in his regular work. And this time was very profitably spent. Students who live in cities have a great advantage, as it is possible to attend evening drawing schools, where they may receive instruction from teachers who have a large experience; but there are many who are not so fortunate, and it is this latter and larger class which it is intended that these talks on drawing may reach and help. As stated above, it is continuous effort which shows results in the long run, just as falling water, drop by drop, will wear away a stone.

But to return to the study of sections. It is often more convenient to show a piece of mechanism in outline, when it is necessary that a section should be made of some particular part. Instead of making a separate section showing this particular detail, it may be shown by dotting the section lining of the part in question. Another method is to merely hatch the outline of the part which is to be shown as sectional. This is shown more clearly in Fig. 14, showing piston. Sections when shown this way are called "dotted sections," and may be used to good advantage when pencilling drawings from which two distinct tracings are to be taken, one showing outline, the other section.

When finished, drawings are made on paper for record work. Sections are often shown in colors, which greatly adds to the clearness of the drawing. Unfortunately, drawings of this class are of little real value for anything except record, as they cannot be given to the workmen, who would certainly deface them, and they cannot be blue-printed. The result is that, in a majority of instances, the tracing constitutes the sole record, and line sectioning has to be resorted to. Tracings possess a great advantage over paper drawings, as they may be blue-printed any number of times, and being thinner, require less room in the files. This may seem a minor matter; but when a manufacturing concern has ten or fifteen thousand drawings on file it amounts to considerable. The proper choice of location for a section is all important, and requires much study and more judgment. As already explained, the function of a section is to add clearness to the drawing, which without it would be more or less confused. The section, or cutting plane, should be so located as to show all the details which need explanation in the clearest manner. In order to do this, it is often necessary to omit certain details of the mechanism which may be beyond the section, but which, if shown, will only confuse the drawing, without helping in any way. For instance, in showing the section of a gear, only the parts which are continuous should be in section, as the hub and the rim. The teeth and arms should be shown in outline. It will not be necessary to dot all the teeth to the gear. This will only add confusion, and increase the labor of making the drawing. If it is desired to show in section a circular flange with a number of bolts through it, all the bolts being equidistant from the center, it will not be necessary to show all the bolts. Only two should be shown, and they should

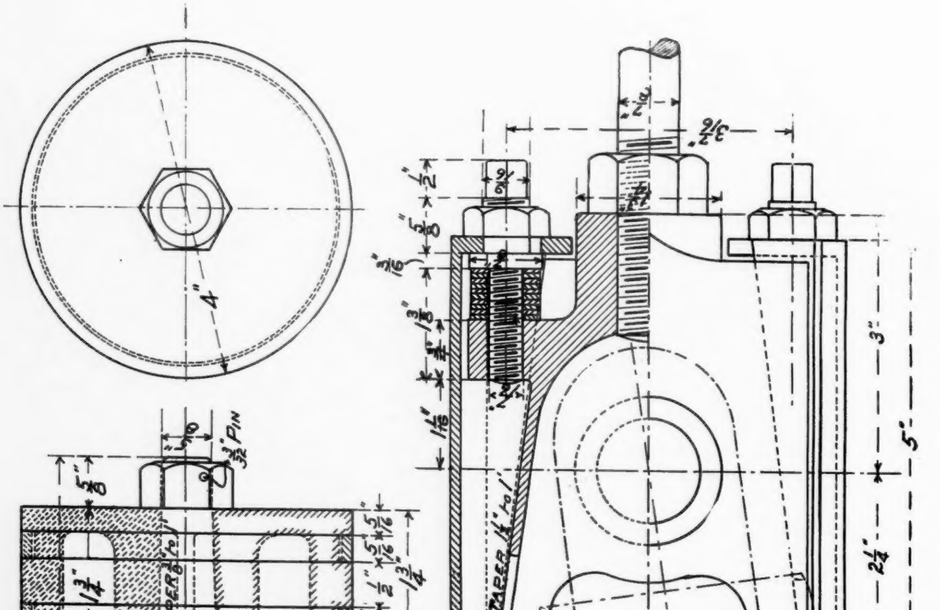

Piston and Rod for
4 x 4 Upright Engine
Scale Half Size Feb. 1, 1902
E.T.C.
Crosshead for
4 x 4 Upright Engine
Scale Half Size Feb. 1, 1902
E.T.C

FIGURE 14.

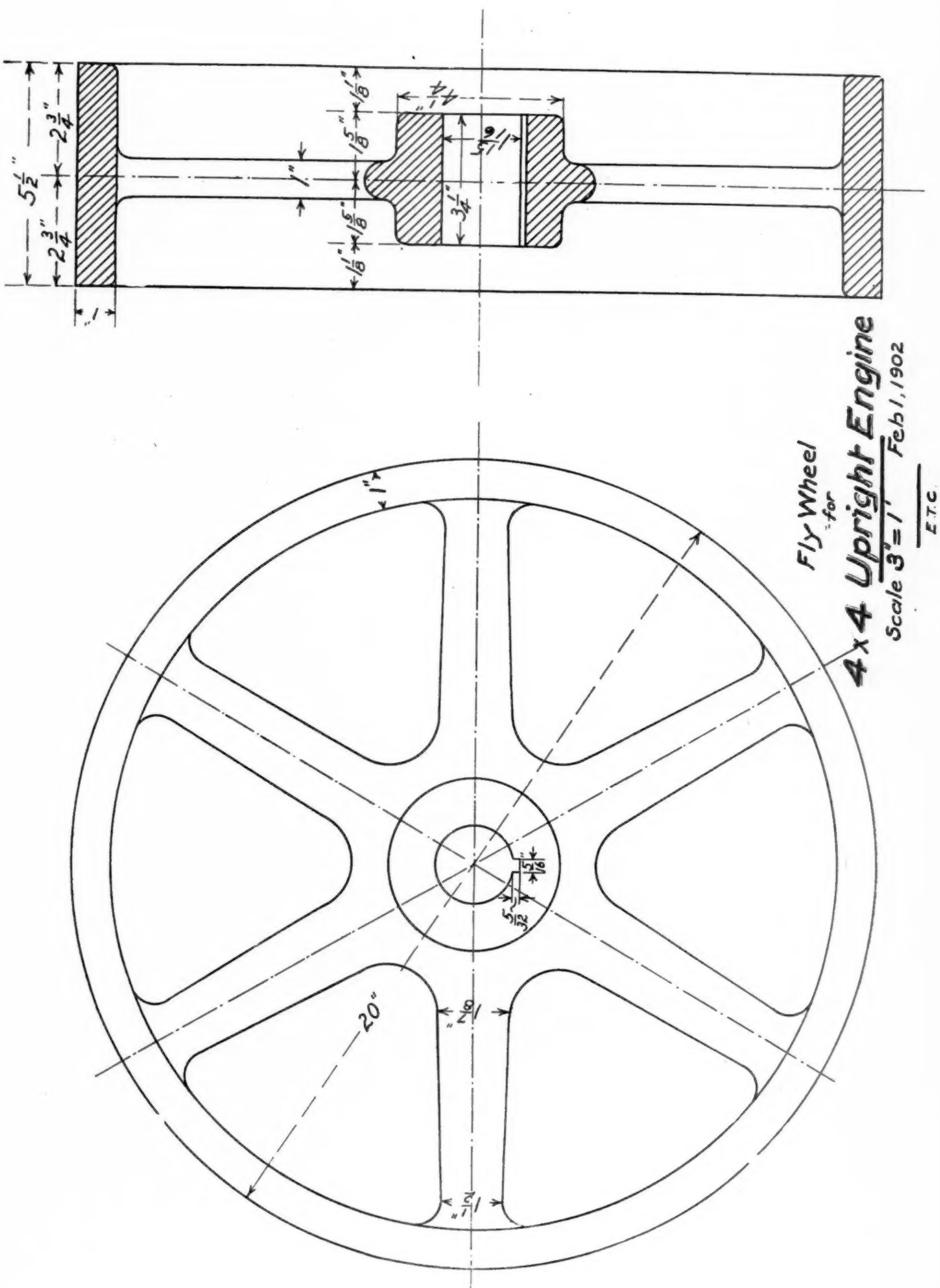


FIGURE 15.

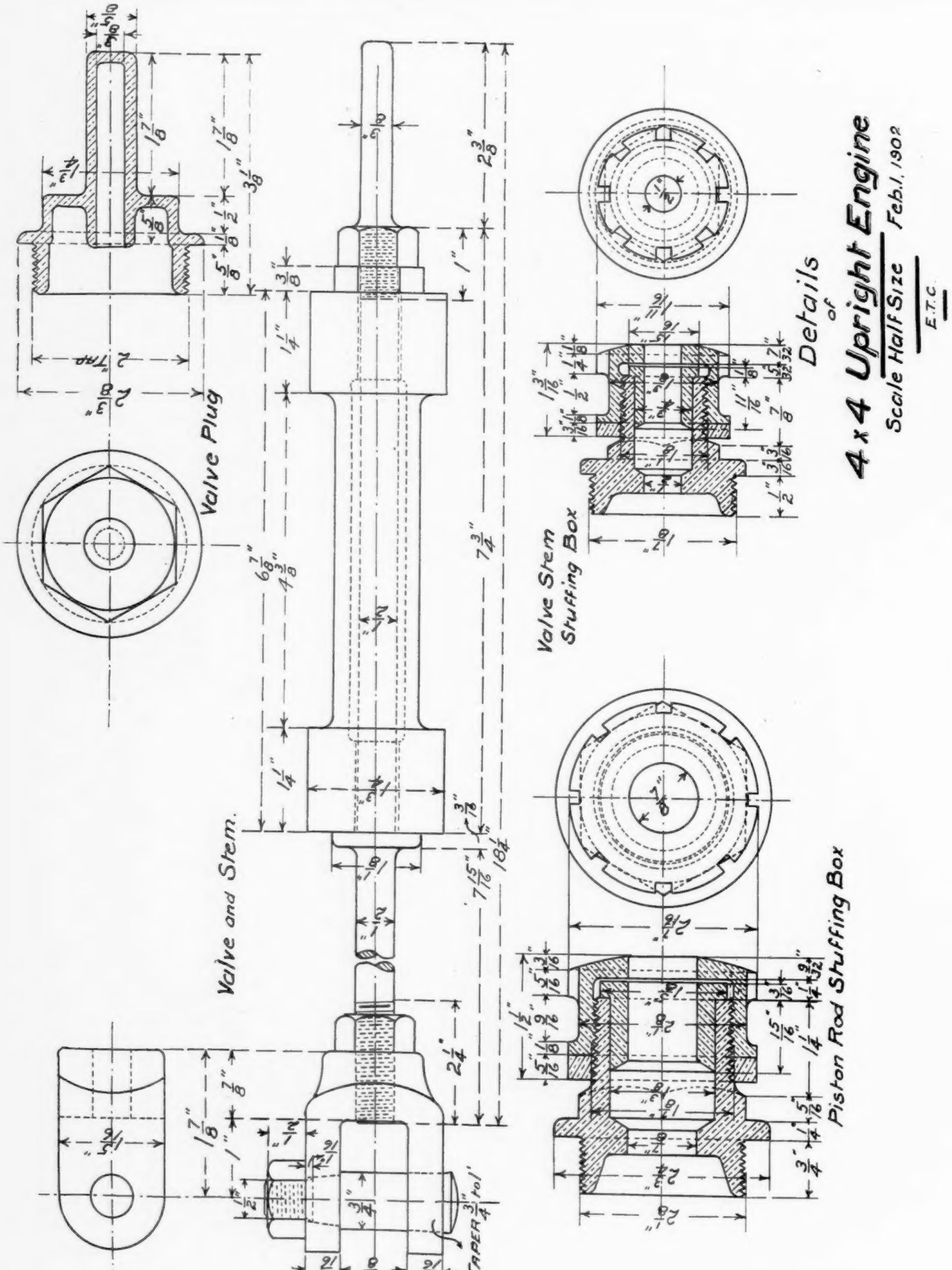

Valve Plug
Valve and Stem.
Valve Stem Stuffing Box
Piston Rod Stuffing Box
Details of
4 x 4 Upright Engine
Scale Half Size
Feb. 1, 1902
E.T.C.

FIGURE 16.

be located in the section at the proper distance from the center, whether they happen to come exactly so in the section, or not. It is not at all necessary that a section be continuous. If it is found to add to the clearness of the drawing to show one part in section and another part in outline, it may be done, or it is allowable to change the plane of a section in different parts of the same object. When this is done, it is customary to show the line of the section by letters, and mark the drawing section on A B C D, or by any other letters which may be readily seen. If it is necessary to show a section of a piece of mechanism which, while it is symmetrical, may not be cut evenly by a section, as, for instance, a cylindrical piece having an odd number of hubs or ears, it will be found expedient to depart from strictly conventional lines, and either show a complete section which is balanced, both sides being equal, or better to simply show a half section through one lug to the center. If a strictly conventional section were shown, it would be misleading rather than helpful, and the value of the sections would be lost. This is a point which cannot be brought out too forcibly. The section is primarily used to add clearness to the drawing, and should be used only when it is necessary to avoid confusion. Never lose sight of the fact that your drawings must be kept as simple as possible. Every line means extra work, and sections require more time than any other part of the work; therefore they should be used only when necessary. It will not be well to go to extremes and try to dispense with sections, for, when necessary, they would be neglected. The proper use of sections cannot be taught in a minute; it must be acquired by practice and judgment. The latter is acquired by the former, so they really go hand in hand. Fig. 14, already referred to, illustrates two distinct methods of showing sections. The detail of piston and rod is really a side and end elevation, but dotted sectioning has been used, and it will be seen that both classes of dotted sections add clearness to the drawing. The type shown in the lower half of the piston is preferable in that it may be more readily accomplished. The detail of crosshead illustrates the ordinary method of sectioning, so far as the upper part of the work is concerned. This also illustrates a method of saving extra drawings in that the upper part is shown in section, and the lower part is in elevation. This is often done and is allowable when an object is perfectly symmetrical. This method adds to the clearness of the drawing, as it shows at a glance the external appearance as well as the sectional arrangements. If it is found expedient to use this method, it is well to show an elevation of the object on the same sheet with the section, thus giving a clearer conception of the object to be shown. Fig. 15 shows the fly-wheel for the 4 x 4 engine. It will be seen that the same general remarks are appropriate for showing this section as for a gear; that is, only the parts which are continuous should be in section. Even if the wheel were turned so that the section line would come through the spokes, they would not be shown in section, as this would give the impression that they were continuous, forming a web instead of being only six in number, as happens to be the case. It will also be allowable to show the keyway on the center line, if thought necessary, but it is preferable to keep to projection as much as possible in this particular case.

The last two illustrations, Figs. 14 and 15, have been of cast iron so far as the sectional work was concerned, and consequently the section lines have been full and evenly spaced.

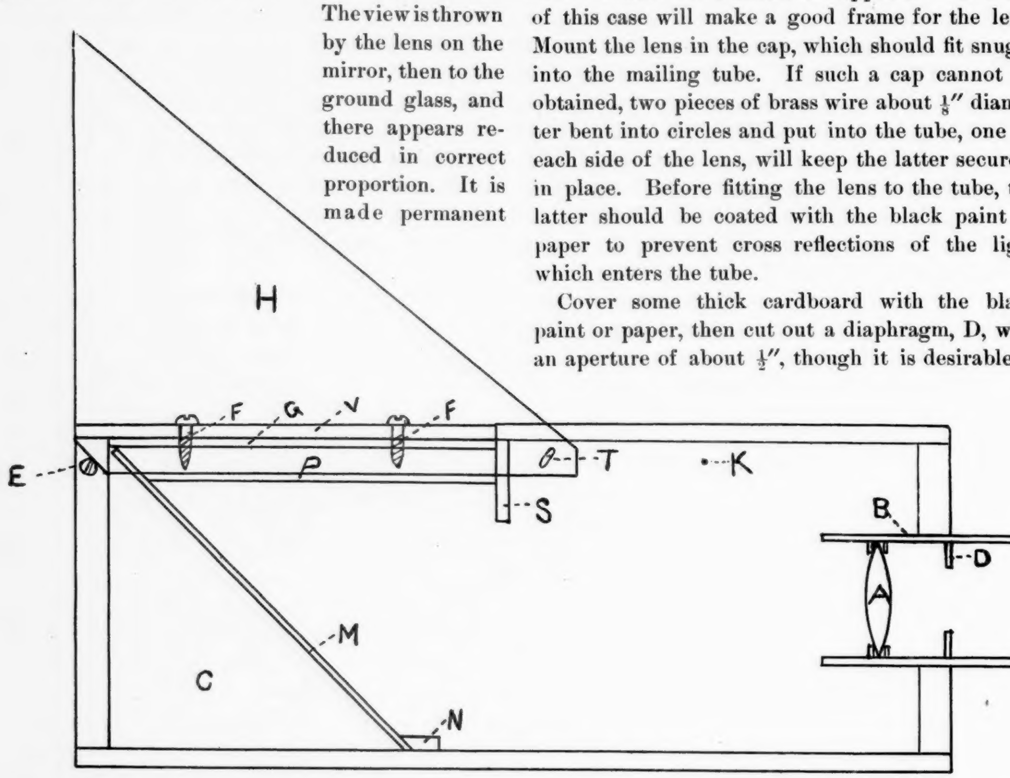
In Fig. 16, showing details of valve and stern, stuffing boxes and plug, is an illustration of the method employed for showing composition, or brass, using the conventional line given in Fig. 9–C. In showing the valve and stern, only one view is necessary, with the exception of the lower end, where the knuckle joint for connecting to the eccentric strap is shown. This has to be shown by two views, as it will be seen that it is not of regular shape, while the remainder of the detail is cylindrical. The valve plug is threaded into the top of the steam chest and guides the end of the valve stem. The stuffing boxes are used to prevent the escape of steam from the cylinder and steam chest, while permitting the rods to slide with comparative freedom.

These details should be carefully copied, and it will be well to enlarge them, making the drawings on a double standard sheet, thus gaining experience in transferring from one scale to another. This will also bring the drawings more nearly to the size and scale required in actual practice.

A CAMERA OBSCURA.

How to Make This Valuable Aid in Landscape Drawing.

To those who find pleasure in landscape drawing, but, from lack of a teacher, cannot master the elementary principles, the camera obscura here described will prove of much assistance. It is easy to make and use, and requires but little expense for the materials used in its construction. The view is thrown by the lens on the mirror, then to the ground glass, and there appears reduced in correct proportion. It is made permanent with pencil or crayon. The practice in drawing thus obtained is valuable to beginners.



The required materials are: a wooden box, a cheap double-convex lens, a piece of mirror and one or more pieces of ground glass, a piece of pasteboard mailing tube, some dull black paint or paper, sheet tin, screws, etc. The first thing to be settled is the lens. The one used by the writer was a discarded photographic lens from a cheap 5″ x 8″ camera that had outlived its usefulness. Any jeweler can supply an ordinary double-convex lens at a small price. One that is 1″ diameter is large enough, though 1½″ would be better. The depth of focus should be as short as possible, and this measurement should be learned when purchasing, as the length of the box depends upon it.

Having secured the lens, get a well-made and smooth piece of mailing tube about 3″ long, the inside diameter of which is a little larger than the lens. From the jeweler also get a case such as the works of watches are shipped in. The cap of this case will make a good frame for the lens. Mount the lens in the cap, which should fit snugly into the mailing tube. If such a cap cannot be obtained, two pieces of brass wire about ⅛″ diameter bent into circles and put into the tube, one on each side of the lens, will keep the latter securely in place. Before fitting the lens to the tube, the latter should be coated with the black paint or paper to prevent cross reflections of the light which enters the tube.

Cover some thick cardboard with the black paint or paper, then cut out a diaphragm, D, with an aperture of about ½″, though it is desirable to have several, with apertures of different sizes. They should be a snug fit to the tube, so as to remain in position. The tube is now ready to be fitted to the box.

The box here described was made for a lens with a 10″ focus, and to give a view on the ground glass measuring 6″ x 8″. The dimensions are easily determined for any other size of lens or ground glass. The box was remade from a pine box secured from a grocer. It measures outside 13½″ long, 8½″ wide and 5½″ deep; the ends being ½″ thick and the sides, top and bottom ¼″ thick.

A few extra pieces of $\frac{1}{4}''$ stock are needed for supports. The top piece does not cover the whole top, but only 7″ of the front or lens end. The inside of the box is coated with the black paper or paint, to prevent absorption of the light rays entering through the lens.

A hole is bored in the front end to receive the lens tube. This should be of such a size as to hold the tube firmly and yet allow it to be drawn out or pushed in for focusing. A good plan is to have this hole large enough to allow a lining of black felt. The tube can then be readily adjusted, and yet no light can leak through around the edges.

The mirror M is placed in the back of the box at an angle of 45 degrees and supported on triangular pieces of wood, C, $\frac{1}{4}''$ thick, and also by a thin beveled cleat, N, glued to the bottom of the box. Two pieces, P, $\frac{1}{2}''$ wide, $\frac{1}{4}''$ thick and 6″ long are screwed to the sides for supporting the ground glass, and are so placed that the glass is even with the top sides of the box at the rear end.

The ground glass should be of medium thickness, to safely support the weight and pressure of the hand while drawing the view. Extra pieces may be provided so that several views may be drawn during a day's outing and carried home to transfer to paper. The glass is held in position by strips of wood, V, $\frac{1}{4}''$ thick and $\frac{1}{2}''$ wide, on the sides and back. These are fastened by screws or screw-eyes.

The hood H is made of tin painted black on the underside and any color desired on the top. A piece $13\frac{1}{2}''$ long and 11″ wide is required. The shape of the sides is shown in the drawing. These are cut out with metal shears and the ends bent over as shown. At J a screw-eye holds the side in place while the back part rests on the round-headed screws E, one on each side, which project sufficiently for this purpose. When not being used, the screw-eye J is removed, the front of the hood moved forward so that the screw-eye may be put in the hole K, thus allowing the hood to be laid flat on the top and protect the ground glass from being broken.

The instrument is now nearly complete. It should be tried by taking it out in the sunlight and focusing on a suitable view. Examine the ground glass to see if the view is correctly and squarely reflected thereon. It may be found desirable to put in a shield, S, made of a piece of wood or pasteboard painted black and of sufficient width to prevent the direct rays which enter the lens from reaching the ground glass other than by reflection from the mirror.

In use it will be necessary to place the camera obscura upon a tripod, camp-stool, or other firm support, as some little time is usually required to draw a landscape and any movement would be troublesome. If the sun should shine, a black umbrella will be useful for a shield, as the less outside light that reaches the ground glass, the more distinct will be the definition. A pencil or crayon, black or colored, may be used for the drawing, doing the upper part of the view first to avoid rubbing.

ASTRONOMY FOR MARCH.

There will be no planets in the evening sky this month, with the exception of Neptune, which does not count for the amateur. Venus will be morning star, rising, at the beginning of the month, two or three hours before the sun, and arriving at her greatest brilliancy, though not at her greatest distance from the sun, on the 20th.

Mercury will be visible in the eastern sky about the 16th, in the morning, an hour or so before sunrise. And the astronomer who cannot get up in the early morning does not amount to much.

Jupiter and Saturn will also be visible in the morning during the month, but Mars is too near the sun, coming into conjunction with it on the 29th.

The moon will enter her last quarter on the 2d, is new on the 9th, comes to the first quarter on the 16th, and fulls on the 23d. She will be in conjunction with Saturn on the 5th, and with Jupiter on the 6th, passing about five or six degrees north of each of them. There will be no occultations of conspicuous stars this month.

The constellations for March will be nearly the same as for February; at 8 P.M. of the 1st the Lion will have wholly risen into the eastern sky, of which he very appropriately occupies the lion's share. The Twins are directly overhead. Sirius has just passed the meridian, and Orion has moved round into the southwestern sky, where he stands nearly upright.

The Great Bear has risen in the northwestern sky to the level of the pole and, with the Lion,

is the principal constellation of the eastern heavens.

Eight hours later, at 4 A.M., all is changed. The winter constellations are set: the Great Bear is a little to the west of the Zenith, and the other bright circumpolar groups are near or below the northern horizon; but the Milky Way lies level across from north to southeast, with Cassiopea, Cepheus, Cygnus, Lyra, Aquila and Scorpio scattered along it,— all summer constellations. Above these are Hercules and Ophiuchus; and Boötes, marked by its bright red star, Arcturus (the Bear's Tail), and the beautiful little broken oval of the Northern Crown, nearly overhead.

The two zodiacal constellations, Virgo and Libra, lie in the south, west of Scorpio, and the small quadrangle of the Crow is low in the southwest. Leo is near setting, and the Twins quite so. Capella, the bright white star of the northern winter sky, is just on the northwestern horizon.

Jupiter is just rising, and Saturn already risen, but in very bad position for observation.

VEGA.

DEVELOPING PLATES.

FREDERICK A. DRAPER.

WHILE the topic here presented is an old one and much has been written about it, the large number to whom photography is new and its processes unknown make it suitable for a place in the columns of this magazine. There are many amateur photographers who do not develop their plates or make their own prints, and who, for no sufficient reason, are reluctant to attempt this work. Could they but once experience the pleasure this most interesting part of the photographic process can give, they would hold back no longer. Those of our readers who are thus situated should provide themselves with an outfit and learn to do their own developing.

Assuming that a dark room is available, a ruby lantern is necessary. This should have both ruby and orange glass, and free from any holes that emit white rays from the inside. The equipment should also include three trays of proper size for the plates used, and two glass graduates. Each article should be labeled and used solely for the particular solution assigned to it. A wash-box and drying frame are also desirable. A very useful and inexpensive device recently put on the market is a rocker for keeping the developer moving while otherwise engaged. It is a piece of enameled iron, with a hole in the top in which the tray rests. Two sides are bent down and rounded. A push on one end will give a gentle rocking motion, which continues for some time, and serves admirably to move the developer across the plate in small waves.

The developer should be that recommended by the manufacturer of the plates used, several formulas being generally given. Many plate-makers issue leaflets containing much information valuable to the novice, and which may be read with profit. After some experience has been acquired, and satisfactory results have not been produced, the troubles should be studied to learn their cause. The exposures may not be correct, and herein lies the most common cause of poor negatives; the plates may be old, the camera, plate-holders and plates not properly dusted; the trays changed, or solutions mixed that should have been kept entirely apart. Watchful care is necessary at all times, but not to the extent of making the work tiresome or disagreeable.

For the first trial any standard developer will answer. The water used for reducing, when necessary, should be distilled, although rain-water, gathered in a clean porcelain or enamel dish, will answer nicely. In addition to the developer a bottle of restrainer should always be kept within reach, in case of over-exposure. This is easily prepared as follows: dissolve 1 ounce of bromide of potassium in 10 ounces of pure water. The cork of the bottle should have a piece of quill or glass tubing run through it, so that a few drops of the solution may be quickly thrown into the developer in an emergency.

To make clearer the process of developing, we will assume that the plate has been exposed for a landscape and we are about to develop with a hydro-metol one-solution developer. The exposure was about correct as to time. The dark-room door is locked, the ruby lantern lighted and placed at sufficient distance so that only a dim light is thrown across the trays. The bottle of developer is opened, the quantity specified is poured into a glass graduate, and to this is added the specified quantity of pure water. The plate is removed from the holder, dusted with a camel-hair brush,

and placed, gelatine side up, in the tray. The developer is then poured over the plate from one end, so as to send it across the plate in a wave that will cover the whole plate. The tray should be gently rocked to keep the developer moving wavelike across the plate. Many photographers wet the plate with water before developing, to facilitate the flow of the developer. In about 30 seconds, faint lines will begin to appear, growing stronger, till gradually the whole plate is covered. The development is continued until the high lights are quite dark, and the milky white appearance has completely disappeared. The view can now be seen with more or less distinctness from the back of the plate. Do not stop development too soon, — a very common error with beginners, — as loss of detail and contrast results. Different makes of plates work differently, so experience is the best teacher in this matter.

Had the plate been much over-exposed, the image would appear instantly the developer was applied. When this occurs, remove at once from the developer and wash with one change of water. Then add to the developing solution from three to six drops of the restrainer above mentioned, according to the degree of over-exposure, and continue development as before. If you have reason to believe that any plate has been over-exposed, use a larger proportion of water when beginning development, adding more developer later. With a two-solution developer, which will be considered at another time, over-exposed and also under-exposed plates are more easily handled by varying the proportions of the different solutions.

Under-exposed plates, which frequently come with snap-shot work on cloudy days, are slower in developing; the high lights, i. e., the sky, water reflections, and white painted houses, etc., appear long before the darker portion of the view becomes visible. Working with a one-solution developer, the best thing to do is to make a very weak solution with water and take a long time in developing. A drop or two of restrainer should be added when this is done, to prevent fog. Also cover the tray with a piece of black cardboard, so that no light of any kind will reach it.

When you think the plate has been fully developed, hold it before the ruby lantern to ascertain the extent to which detail has been brought out. If fully developed, plate should be quite dense.

After developing, place the plate in the washbox and wash with cool running water for 15 minutes. Do not allow water to run directly down on plate. The water should run only fast enough to carry off the excess chemicals. If running water is not available, change the water six or eight times. It is then ready for fixing. Make a saturated solution of "hypo" and keep it in a labeled bottle. Have a fixing tray similarly labeled and use for no other purpose. Take equal parts of "hypo" solution and pure water to fill the tray one-third full. Place the negative in the tray, film side up, and rock as before directed, keeping it in the fixing bath at least two minutes after the yellowish color on the back of the negative has entirely disappeared.

Another washing for at least 15 minutes, though a half-hour is better, completes the work of developing. The negative should be allowed to thoroughly dry in a drying rack before attempting to make prints. Owing to the time required for the several washings, it is desirable to develop several plates at one time. It is also more economical to do this. The time required in washing one plate can then be used in developing and fixing of others. In changing the work from developing to fixing, or the reverse, wash the hands in water, without soap, and dry with a clean towel. At all times use precautions to keep the hands free from chemicals. After fixing, the negative can be freely exposed to white light.

The process here described may seem, at first reading, complicated and difficult, but a few trials will make it very easy. When it has become familiar, a two-solution developer is recommended, as it gives a greater range of adaptability. The uses of the different chemicals will then become evident, and effects can be gained in negatives that would be otherwise difficult to attain.

IN some of the mines in Pennsylvania the owners are providing for the safety and convenience of their employees by installing telephones at regular intervals along the shafts of the mines. In mine accidents it has often happened that the whereabouts of imperiled men could not be found out, and thus the work of rescue was delayed and lives were lost. It is believed that the telephone will remove much of this trouble.

HOW TO BUILD A HOUSEBOAT.

Carl H. Clark.

II. Construction of Deckhouse.

Before starting work on the deckhouse, the doors and window-sashes should be obtained, as the studs in the framing have to be spaced to them. The windows on the sides shown in Fig. 1 are about 3′ square, and those in the ends about $2\frac{1}{2}'$ wide and 3′ high. The doors are about 27″ wide and $1\frac{1}{4}''$ thick, except the front doors, which are double and together are about $3\frac{1}{2}'$ wide. The front and back doors opening on deck are to have casings and preferably may be rather thicker than the others. These sizes are by no means absolute, and the stock available may govern them somewhat. The general framing of the house is shown in Figs. 9, 10, 11 and 13, 9 being a side view, 10 a front-end view, 11 a rear-end view and 13 a section. The several members (Fig. 13) are as follows: *a* is the lower sill, fastened directly to the deck of the hull; *c* is the studding, which is nailed to the lower sill, and is the framework for the sides of the house; *b* is the

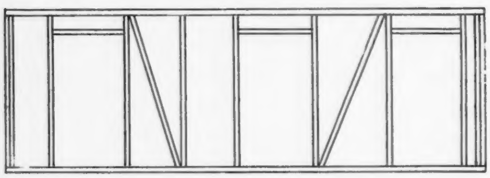


Figure 9.

upper sill, running along on the tops of the studs; *d* the roof beams, their ends resting on, and fastened to, the upper sill; *f* is the outside sheathing; *g* the inside sheathing; and *h* the roof planking. The frame is all of 2″ x 4″ spruce. The sills are to be gotten out first. For the lower one, which runs around the house, there are two pieces 19′ 10″ long, and two 15′ 9″; for the upper one, which is on the sides only, there are two pieces 19′ 10″ long. The four pieces of the lower sill are laid in place on the deck, and the ends joined together, as in Fig. 12, by cutting away half of each. This sill is then to be fastened down to the deck, being sure that it is square and rightly placed. With the lengths given, there should be about $1\frac{1}{2}''$ on each side between the sill and the side of the hull. A coat of thick paint is put on under the sill, and it must be strongly fastened down, as the safety of the house depends in a great measure upon it. About a dozen lag-screws, or bolts, should be used, being driven down into the beams below, with spikes elsewhere.

The cabin arrangement, as in Fig. 2, can be laid out with chalk on the deck, and the positions of the windows and doors located, as the studs are placed directly against the side of the door and window casings. The studs for the sides are cut 6′ 3″ long, 11 for each side. These are set up on the lower sill and nailed in place. Those at the corners are double. The ones at the windows are placed about 2″ farther apart than the width of the sash, to leave room for the frame, and must be straight and parallel. The top side sill is laid along on the tops of the studs, and they are lined up parallel and nailed to it.

The frame of each side must be squared up and braced temporarily from the deck, and the roof beam

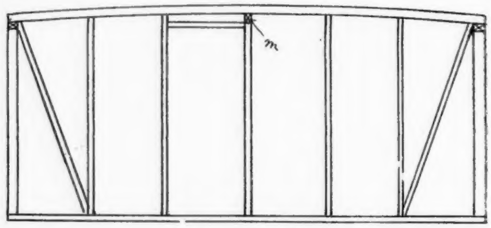


Figure 10.

at each end put in place, as in Fig. 13, at the ends of the upper sills, and fastened to them. A piece of 2″ x 4″, 19′ 10″ long, and planed all over, is placed under the middle of these roof beams to serve as a support to them, as shown at *m*, Figs. 10 and 11. This support, or strongback, as it is called, should be braced up from the deck until the middle of the beam is 3″ higher than the ends; this gives the roof a "crown" and makes it shed water.

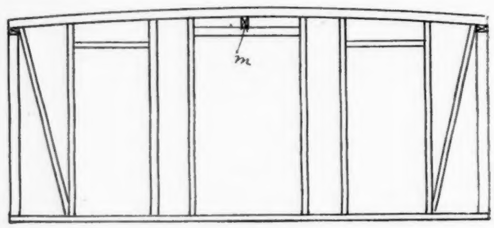


Figure 11.

The rest of the end studs are cut to fit between the sill and the roof beam, those beside the doors being fitted to the door-frames, and the one in the middle of the after end is placed under the strongback, permanently. The diagonal braces are now to be put in place, as shown in Figs. 9, 10 and 11. They should be a tight fit and be strongly nailed, as they stiffen the house and prevent its working. The horizontal pieces just above the windows and doors are cut to fit singly between the studs; those over the windows are so placed that when

$\frac{7}{8}$ inch is allowed for the frame, the window will be in the desired position. In the sketch they are about 6′ above the floor. In any case they must be high enough so that the sash will drop down flush with the window-sill before striking the floor. The pieces over the doors are put just under the fore and aft strongback. That over the front door is double, two 2″ x 4″ on edge, and strongly nailed, as it supports the front end of the strongback, as shown in Fig. 10.

The roof beams are spaced about 18″, and there are 12 beams evenly spaced. They rest on the strongback and are bent down and fastened to the upper sill. It will be necessary to brace the strongback from the deck in two or three places to prevent it from sagging in bending the roof beams. The two lower edges of

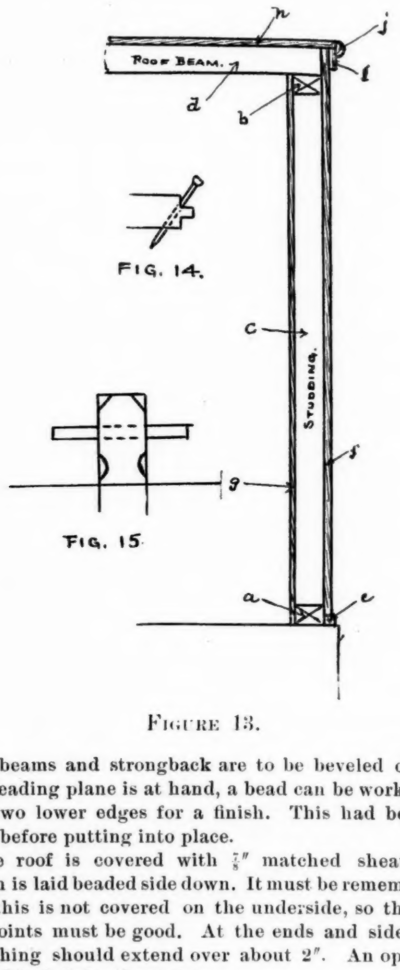


Figure 13.

both beams and strongback are to be beveled off, or, if a beading plane is at hand, a bead can be worked on the two lower edges for a finish. This had best be done before putting into place.

The roof is covered with $\frac{7}{8}$″ matched sheathing, which is laid beaded side down. It must be remembered that this is not covered on the underside, so that all the joints must be good. At the ends and sides this sheathing should extend over about 2″. An opening should be left for the stairs.

If it is desired to have the house especially strong, a $\frac{1}{2}$″ iron rod can be run near each corner from the upper sill down through the lower sill, and a deck beam below with a nut and a washer at top and bottom. This ties the house down securely. A strip $1\frac{1}{4}$″ x 1″ is gotten out and laid flat on the deck all around the lower sill, as shown at *e*, Fig. 13, forming a bed for the outside sheathing, being mitered at the corners. The front and back door-frames are now put into place and carefully nailed to the studs, being fitted over the sill at the bottom, and just under the joist at the top. They should be of such a width that their edges will come just even with the outer surface of the sheathing when it is in place. This width is about $5\frac{1}{2}$″.

The window-frames are made of $\frac{7}{8}$″ stock about $5\frac{1}{2}$″ wide, fitted in between the studs. The top is fitted first, and the sides are fitted against the top and should extend to the floor, to ensure the windows running smoothly. As described, no allowance has been made for window weights. If these are desired to balance the windows, the studs must be put enough farther apart to admit them, and pulleys must be fitted at the top of the frames. The windows will probably be fully as satisfactory without them, however, as the sash is not heavy.

Just under the window-sill, two pieces are fitted between the casings, on edge, as in Fig. 16, to hold the ends of the sheathing, leaving a space between for the sash to run. If desired, the door-frames can be built up in the same way as the window-frames, of $\frac{7}{8}$″ stock, and a strip fastened around to form the door-jamb.

If the house is to be used in other than warm weather, a layer of paper, such as is generally used for building purposes, should be put on before sheathing; it comes in rolls, and can be tacked to the studs to hold it in place. It will add much to the warmth of the house.

The sheathing is $\frac{7}{8}$″ thick, matched, and put on with the beaded side outwards. The joints with the bottom strip must be good, but at the top, under the roof, it is not as important, as the joint is covered. At the sides of the door and window frames the sheathing has to be fitted, but extreme care is not necessary. The grooves in the joints should all have a coat of lead before putting up, and the nails should be "set" $\frac{1}{4}$″. A strip, *i* (Fig. 13), about 4″ wide is worked around just under the roof boards, to cover the joints at the top and make a finish. At the corners it is mitered.

The roof sheathing is trimmed off even with this strip all around. The opening for the stairs is also trimmed out square and even, and a coaming about 3″ deep fitted around underneath at the edge. The opening should be about 3′ long and 2′ wide.

The roof and the decks at the end are covered with canvas; about 6-oz. duck, or even heavy drilling, will answer the purpose. It comes in rolls, usually 30″ wide. The several strips are laid fore and aft, beginning with one down the middle, and working towards the edges, lapping each one over the next outer one, like the shingles on a house, and tacking with small copper tacks. Each length should be laid in a heavy coat of paint and should be stretched somewhat, to be

sure of its lying smoothly. At the sides and ends, and also in the opening for the stairs, the canvas is turned down over the edge and tacked, and then trimmed off just under the row of tacks. A piece of molding, or a half-round strip, as shown at *j*, Fig. 13, is nailed around just even with the edge, to cover the canvas and keep it in place. The top will need at least two coats of lead paint to wear well. The decks at the ends are covered in the same way, except that where the canvas comes against the house it is turned up and a $\frac{3}{4}$″ quarter-round molding worked into the corner. The edge here is best covered by a 2″ half-round, which can run the full length of the hull, and adds somewhat to the appearance, especially if varnished. Although the house is best when sheathed inside, for some purposes, as for a hunting or shooting camp, this may not be necessary; in which case the studs and sills ought to be planed all over. If inside sheathing is desired, it may be $\frac{1}{2}$″ thick and matched. It is jointed to the floor, and may, if desired, be stopped at the lower edge of the roof beams, and a molding carried along the top; or, if a little better finish is wished for, it can be carried up to the roof, being cut out around the beams, in which case the molding is put up against the roof. This sheathing ought to be blind nailed, as in Fig. 15, so as to leave no nail holes. A fairly good joint around doors and windows is all that is necessary.

The windows are to be finished by fitting a window-sill on both inside and outside, as shown in Fig. 16, leaving a slot for the window. These sills should be neatly fitted between the frames, and be wide enough to extend out over the sheathing and fit against the casing. This casing is about 4″ wide, worked around the window, as in Fig. 1, $\frac{1}{2}$″ thick on the inside and $\frac{7}{8}$″ on the outside. Above each outside casing there is a strip of lead or zinc turned at a right angle and laid along on the top of the casing, and tacked to the sheathing. This prevents rain leaking down behind the windows. The sashes are put in place and a strip nailed around to hold it in place and make a groove for it to slide in.

As balance weights have not been provided, some kind of binding arrangement must be used to keep the sash in place. There are little eccentric arrangements sold for this purpose. The bottom of the sash should fit tightly against the sill, and a piece of rubber weatherstrip should be tacked on the sill to bear against the sash and prevent from running down between the sill and sash. The partitions are single, of $\frac{7}{8}$″ matched stock, finished both sides. They are held in place by a quarter-round molding each side, both top and bottom. The lines of the partitions are marked out on the deck, making the middle one just inside the strongback under the roof beams. The inner quarter-round is nailed down, and the sheathing nailed to it and the floor. The outside molding is put on after the partition is all up. This partition ought to extend up to the roof, and be fitted around the beams. At the doors short pieces are used above, and the opening trimmed out to fit the door. Care must be taken not to drive any nails through the roof to cut the canvas. There are also moldings in the corner between the partitions and the side sheathing. An ornamental molding like the one already run at the side under the beams, if carried around the partitions at the same height, will take away the bare effect, and add to the appearance. The openings for the doors in the partitions have to be fitted with casings the same as the windows. These are about 5″ wide, except that the outside casing projects about an inch into the opening, making a jamb for the door to shut against. The door-sill is about 6″ wide, beveled off on the sides, and joined to the molding already put around the bottom of the partitions. The doors can be hung, using butt hinges, which do not show. Some kind of latch or knob should be fitted, to hold the doors shut, and locks if desired.

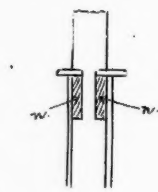


FIG. 16.

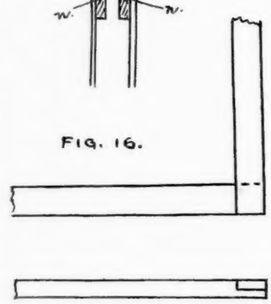


FIG. 12.

The hatches in the deck are trimmed out about 2′ square, cutting out the top layer first and allowing the lower layer to project 1″ to support the cover. The cover is made of two layers, the upper one of the same stock as the floor boards, and cut to fit accurately. The lower layer is nailed across the upper, and the two being crossed, the cover cannot warp. A sunken handle or ring should be attached for lifting.

The stairs to the roof run from about the middle of the boat diagonally up to the opposite side of the opening above. They are made of two planed 2″ planks about 8″ wide, resting on the deck and against the edge of the opening. The steps are about 8″ apart, dividing the distance equally. A cleat about 2″ wide is nailed under each end of each step to support it. If thought necessary, a hand-rail on the outer edge of the stairs can be provided.

The railings are 2″ x 4″ planed joists, with a post of the same material every three or four feet apart. They are about 3′ high, and should run around the top of the house, around the opening for the stairs and around the decks at the ends. The posts at every corner are braced with a diagonal brace or a bracket of iron fastened into the corner. It will be necessary to nail these posts through the canvas to the deck, and care must be taken not to injure the canvas more than necessary. These parts should also be placed just over a roof beam when possible. At the after end a piece of rail about 3′ long should be hinged to allow a landing-place.

Some arrangement must be made for mooring the

boat, either ringbolts or bitts, one near each corner. If the former are used, they should be driven through a deck beam, and have a nut screwed up tight on the underside. A tight-fitting washer should be slipped on first to bear on the canvas and prevent tearing.

The bitts are rather more satisfactory on the whole. They are made of pieces of timber about 4″ square, running through the deck and fastened to the bottom timbers. The top end is about 10″ above the deck, and is champhered off, as in Fig. 15. A ¾″ rod is driven through and allowed to project about 5 inches each side. Either arrangement must be strongly made, as there is considerable strain in a heavy wind and in towing. Another and probably easier way of doing this is to make cleats out of oak or other strong wood, about 12″ long and 4″ high. These are bolted down to the deck with two bolts each, one bolt passing through a beam. If preferred, these can be purchased at a ship chandler's, in either iron or wood.

An awning framework is made of 2″ square spruce. There is an upright in each forward corner of the forward deck, a few inches shorter than the height of the house; there is a piece of similar size connecting the tops of these uprights, and also a piece extending back to and fastened to the house. This makes a framework on which the awning will lie evenly. Or a rather neater frame is one of galvanized iron pipe, which is readily done, and is not expensive. An ornamental awning of striped duck will add to the attractiveness of the boat.

The house, as soon as completed, must be painted on the outside, and should have two coats, leaving a third to put on just before launching. The inside may be painted or finished natural, as desired; the latter is perhaps the best, as it is more durable. The surface should be first treated with a coat of oil, and then whatever finish is desired, put on after that. There are several kinds of oil finishes on the market, or shellac and varnish can be used. The canvas on the roofs and decks must be kept well painted, so that the wear will come on the paint and not on the canvas, as this would soon wear it through and cause leaks.

CORRESPONDENCE.

(No. 6.) ELKHART, IND., Jan 27, 1902.

I would like to know whether it is possible to make a call-bell telephone out of the following materials suitable for a line one mile long:

Two ordinary electric bells,
Two telephone receivers,
Two push-buttons,

and wire and batteries sufficient for one mile. Also give a diagram showing the method of connecting the wires. C. H. W.

The materials you mention are suitable only for a short line. If you want to run a line for a distance of one mile, you would need 10 or 12 cells to your battery to get sufficient energy. These would cost more than would a cheap magneto-telephone. You would also need double-contact push-buttons. A series of articles on telephony are in preparation which will give complete information about the equipment of short lines.

(No. 7.) MENDOTA, ILL., Feb. 5, 1902.

I wish to make an induction coil which will give a spark about one-fourth of an inch long. What sizes of wire are best for each coil, and how much of each is necessary? Is it necessary to have a condenser? Will such a coil operate the apparatus for wireless telegraphy described in the November number of AMATEUR WORK? M. E. F.

The following are the dimensions for a coil giving a one-half-inch spark, this size being given as it requires but little more work or material than the smaller size, and is much more satisfactory in operation.

Length of coil,	5½ inches
Length and diameter of core,	6 x ⅝ inches
Condenser, 40 sheets tinfoil,	6 x 3 inches
Primary coil, 2 layers cotton covered,	No. 18 wire
Secondary coil, 1 pound, silk covered,	No. 40 wire

A condenser is desirable when a large, fat spark is desired. It would not be advisable to make the apparatus described in the November issue, other than to illustrate the apparatus used by Dr. Hertz, which was the idea in view in that article. The description of how to make a wireless telegraphy apparatus that will operate over water for a distance of about two miles is now in preparation.

(No. 8.)

Can you tell me the process used for finishing mahogany to obtain the very dark, rich crimson and black colors seen on the best of mahogany furniture, etc.? Also, can birch be finished in the same manner to imitate mahogany? F. W. P.

To finish mahogany, maple, birch, white wood and other woods so as to obtain the dark, rich mahogany colors mentioned by this correspondent, proceed as follows: Make a solution of bichromate of potash, using about two ounces of potash to a pint of water. Apply this to the wood before staining. If a very dark tint is desired, several coats may be necessary. It would be well to take a small piece of the wood used and experiment to determine the necessary coatings. The solution may be made either stronger or weaker; the stronger the solution, the darker the tint. After the coating of potash is dry, smooth the wood with fine sandpaper, then apply the stain, which may be red or brown as desired, and finish with varnish or polish. A weak solution of nitric acid is sometimes used in place of the potash.

MARCONI claims to have perfected his telegraphy apparatus so as to avoid interruptions by other systems.

LEECHMAN'S LECTURE.

His Topic, "Motor Bicycles," attracted Record-breaking Attendance.

At the last session of that admirable institution, the Cycle Engineers Institute,— of which America might profitably have a counterpart,—"Motor Bicycles" was the topic, G. Douglass Leechman, M. C. E. I., being the lecturer. The subject was of such interest that it served to attract a record-breaking attendance, nearly three hundred members being present.

After remarking its uses and economies, Mr. Leechman asserted that the motor bicycle cannot be regarded as a single entity, but as consisting of two separate and distinct parts — the bicycle and the motor. In nearly all cases it is a bicycle to which a motor has been supplied, and the people who bought and used motor bicycles were those who had already become expert in riding the ordinary safety bicycle. The motor can be placed in almost any position on the machine that the designer pleases,— in the front, the middle or the rear,— and the bicycle will go and keep upon its keel.

The two points to decide were (1) which wheel to drive and (2) where to place the motor so as to drive the bicycle easily and avoid sideslip. Some people supposed it was an advantage to have the center of gravity low, but from a purely balancing point of view on a bicycle, it is desirable to have the center of gravity as high as possible, in order to avoid sideslip.

There are two causes of sideslip. First, from riding over uneven, greasy surfaces; and in this case, if the center of gravity is low, the rider will not have a chance to recover himself. The higher the center of gravity, the slower the oscillation and the more chance there is of correcting any disturbance. The second cause of sideslip is the endeavor to overcome centrifugal force when turning a corner. Take the case of a rider coming fast around a corner; the rider wants to go one way, but the machine would much rather go off at a tangent; but in this case the position of the center of gravity makes no difference, and need not enter into the calculations.

As regards the durability and successful working of the motor, as a rule it will be found that the higher it is from the ground, the less likely it is to be influenced by mud, dust, etc. This is a small point, but a practical one. Another point in favor of keeping the motor high is that when it is placed low it does not allow of much clearance from the pedal cranks, and things have to be cut very fine to get a proper length of crank-shaft, bearings, and sufficiently large fly-wheels, etc. Thus it is not advisable to get any part of the motor within the line of the chain wheel. A good deal of attention has been paid in recent years to the width of tread, but this is not a point that should worry the designer of a motor bicyle. If the motor is a good one it will not need much pedaling, and so far as sitting still is concerned, it is quite as comfortable to sit with feet a little wider apart than is the case upon the pedal-propelled safety. It is also necessary to get the motor in a position where it will secure a draft of cool air, but not so as to cook the rider.

Another point requiring careful consideration is the inclination of the cylinder. It is much better for the motor to be run vertical, and it is certainly much preferable for the valves to be in an upright position, since in that position they are much more reliable in their action. When the inclination is great, it is possible that the motor will run all right for a time, but it cannot be expected to give continued satisfaction. There is certainly some scope for ingenuity in the arrangements of the various taps and levers, etc., and all electrical apparatus should be worked from the handle, since it is often very awkward for one to loose the grip of the handle in order to attend to taps arranged along the top rail or elsewhere. After some remarks upon the necessity of good brakes, Mr. Leechman spoke of the tendency in some quarters to substitute chain driving for belt, and when one remembers the high pitch to which the art of chain-making has been brought, it is easy to see that good results are possible. Upon an ordinary cycle the chain is good, but upon the driving gear of the motor there is no dependence upon muscular energy, so that if the belt is quieter it is preferable.

—*The Bicycling World.*
